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EDITORIAL.

Lawn Grasses and their Maintenance.

Inquiries are frequently received by the Department of Agriculture regarding the most efficient methods recommended for the establishment and maintenance of lawns, tennis courts or other places on which good turf is essential.

In order to meet this demand for information an article by Mr. J. Lambourne, Assistant Agriculturist, is published in the present issue.

The writer of this article has had considerable experience of his subject and he has set forth in detail the information so accumulated in respect of the most suitable species of grasses to use and the best methods to adopt in preparing the ground, planting and maintaining a lawn in good condition after it has been established.

An article of this type would be incomplete without a reference to insect pests and to methods for controlling them. The section which concludes the article is therefore devoted to this aspect of the subject, and the recommendations continued therein will be found to be both effective and inexpensive.

The Rambutan and its Propagation.

It is common knowledge among fruit growers that most cultivated fruit trees when grown from seed do not ordinarily reproduce the characteristics of the parent tree from which the seed was obtained. This being the case, it is usual to resort to vegetative propagation for increasing the numbers of a desirable kind.

In this number we reproduce an article by Mr. J. Lambourne, who deals with four methods of vegetative propagation of the rambutan. The rambutan is a well-known Malayan tree, although, as the author points out, probably not indigenous to the Peninsula.

There is a considerable variation in rambutan fruits in respect of size, colour and quality and it is to this variation the article owes its origin.

The Sapucaia Nut.

In this number we also print an account by Mr. T. D. Marsh, Acting Senior Assistant Agriculturist, of the experimental cultivation of the Sapucaia, belonging to the Natural Order Lecythidaceae. These trees are natives of the Tropical Zone of South America, and

five species of these produce edible nuts, which are superior or at least equal in quality to those of the Brazil nut tree. The introduction of these nut-bearing trees was carried out by the Department of Agriculture, S.S. and F.M.S., in 1926, when two plants each of three species were brought from the Royal Botanic Gardens, Kew. Of these, one species proved to be suited to Malayan conditions and is now well established.

Although it is considered that one species has shown itself to be adaptable to local conditions, this species has not been sufficiently studied to allow of recommendations being made for planting it as a plantation crop. There are, however, indications that it might be cultivated profitably in *kampong* where land is available.

Original Articles.

LAWN GRASSES AND THEIR MAINTENANCE

BY
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Introductory.

Information is frequently sought as to the most suitable grass for use in making a lawn, tennis court, golf green or it may be the fairway of a golf course, a playing field or an aerodrome. In addition, the best way to establish a suitable turf for these purposes, and its subsequent upkeep, are subjects about which information is often required. This article is planned to supply briefly such information as is available in so far as it applies to conditions obtaining in Malaya.

Growth Habit of Grasses.

As a preliminary to the production and maintenance of turf some knowledge of the habit of growth of grasses is required. Grasses branch or "tiller" from the base, the buds being produced in axils of the leaf-sheaths and close together at the base of the plant. The main object in turf production is to keep them in this position for, if grass is allowed to grow without check, there is elongation of the internodes and flower stalks are produced. For the formation of turf it is necessary to cut grass before it reaches this stage of growth.

Suitable Grasses.

Perennial grasses which will grow for an indefinite period are necessary for turf production. The most suitable are those which can creep and cover the ground rapidly but when kept cut will form a compact turf. A comparatively coarse grass is suitable for the formation of turf on a playing field, golf course fairway, teeing ground, or an ordinary lawn, but for tennis courts, putting or bowling greens, a fine-leaved grass resistant to wear is desirable. For purposes where a smooth even surface is required, it is desirable that the turf should be formed with one species of grass only, for mixed grasses often produce an uneven surface.

Where a coarse grass may be used, Carpet grass (*Axonopus compressus*) is undoubtedly the best, but there are a few others, both native and introduced, which serve the purpose well, when kept mown. Among these may be mentioned Rumput Kerbau or Buffalo grass (*Paspalum conjugatum*), Love grass (*Chrysopogon aciculatus*), and Rumput Pahit (*Paspalum platycaulon* Poir.). This species was, however, referred by Ridley (5) to *Axonopus compressus* Beau.

For tennis courts, putting and bowling greens, Bermuda or Serangoon grass (*Cynodon dactylon*) is the best for the plains of Malaya, while Australian Blue Couch (*Digitaria didactylon*) is suitable for the hills. *Zoysia pungens* grows well

in sandy soil and might prove suitable under such conditions, but it is rather stiffer in growth than Bermuda grass. *Digitaria longiflora* is a local grass with a low-creeping habit and may be useful for the above purposes under suitable conditions. There are also several of the coarser native grasses which, when well tended, make good turf for both tennis courts and golf greens.

Descriptions of Grasses.

Carpet grass, (*Axonopus compressus*), also known as Louisiana grass, is a native of the West Indies, but is widely distributed through the southern United States of America and South America from Mexico to Argentina and Chile. Seeds of this grass were introduced from the Bureau of Plant Industry, U.S.A. Department of Agriculture in 1921 and planted at the Central Experiment Station, Serdang, in 1922. From the stock thus obtained, this grass is now widely distributed throughout Malaya, where it has been used for making lawns, playing fields and, recently, aerodromes.

Carpet grass is a perennial creeping species forming a dense turf. It is easily distinguished by its compressed two-edged creeping stem rooting at each node and by its narrow, linear, blunt-tipped leaves. The flower stalks are two or three in number produced from a terminal node. They are very slender, and grow to a height of one to one and a half feet, bearing three or four spikelets near the apex.

As previously indicated in this article there is some uncertainty as to the correct name of this grass, for *Axonopus compressus,* by which name it is known, has been used by Ridley (5) for another introduced grass previously known as *Paspalum platycaulon*. The latter grass is also from the West Indies, but differs as regards habit of growth and leaf form from Carpet grass. Burkill (6) appears to have confused this grass with the Carpet grass that is being distributed from the Central Experiment Station, Serdang. The superficial differences between these two grasses are that Carpet grass has a narrow linear rather stiff leaf with straight edges, while Ridley's species has broader and softer leaves, more often lanceolate than linear with undulating edges and a rounded base. The two grasses are easily distinguishable when seen side by side.

Buffalo grass or Rumput Kerbau (*Paspalum conjugatum*) is a creeping grass with long stout stolons and leafy slender culms (stems) one or two feet tall. The leaves are bright green, six inches long by half an inch wide, linear-lanceolate with hairy edges. Two slender flower-stalks about 4 inches long are produced from each terminal and bear spikelets in two rows. According to Ridley (5) this grass was probably introduced from South America.

Love grass (*Chrysopogon aciculatus*) is a perennial grass with short horizontal stems and ascending flowering stalks which produce seeds that adhere to the clothing. It is very common in south-east Asia and occurs also in the Mascarene Islands and West Africa. So long as it is kept properly mown this grass is quite suitable for lawns and playing fields.

Bermuda or Serangoon grass (*Cynodon dactylon*) is a perennial creeping grass with narrow linear glaucous leaves and slender erect stems having three to six terminal, spreading, slender spikes. This species is found in all parts of the Peninsula growing by roadsides, in sandy spots by the sea and sometimes on cultivated ground. It is the grass most commonly used for the production of turf on tennis courts and golf greens. Its growth under these conditions is not strong enough to combat the inroads of weeds and other grasses, therefore constant attention to weeding is necessary.

Australian Blue Couch (*Digitaria didactylon*) is a low-growing, narrow and glaucous-leaved grass, which grows in compact tufts and spreads by runners. It is found wild in the Mascarene Islands, Australia and Tonkin, and was introduced into Malaya in 1911 from the Botanic Gardens, Sydney, Australia, and cultivated at the Experimental Plantation, Kuala Lumpur. This grass grows fairly well on the plains, but is more at home in the hills of Malaya. Like Bermuda grass it requires careful attention, otherwise it will be smothered out by native grasses and weeds.

Zoysia pungens is a dwarf fine-leaved tufted grass with branched leafy stems bearing slender spike-like panicles easily distinguished from either Bermuda or Blue Couch grasses. This grass is common in sandy soil, often forming a dense turf which varies according to the locality, being taller in moist situations. This grass when cut regularly forms a good turf although it is somewhat stiffer than Bermuda grass.

Digitaria longiflora is a small creeping species with small, lanceolate, glabrous leaves. It is found growing wild in various parts of the Peninsula and under suitable conditions would probably make a good turf for lawns.

Preparation of Ground.

Successful turf production depends, to a large extent, upon preparation of the ground before it is laid down. Attention to drainage, a suitable top soil and also to the selection of a suitable grass for the purpose required, is essential if disappointment and perhaps expenditure later are to be avoided.

Drainage.

Adequate drainage should be provided at the outset, for one of the most common causes of poor grass growth is inadequate aeration of the soil. In the tropics, two forms of drainage are usually required, (1) provision for taking away surplus rain water quickly and (2) soil drainage to prevent water-logging and to provide proper aeration at the roots of the grass. In order to remove surplus rain water quickly, all hollows should be avoided when levelling, and where possible, the centre of the lawn or playing field should be slightly raised so that water will run off into open drains provided for the purpose. Soil drainage can best be effected by the use of earthenware pipes placed at suitable intervals according to the nature of the soil.

Where a lawn or green is made at the base of a slope or cutting, seepage often occurs. To prevent this, a deep drain should be dug at the base of the slope, and the surface nearest the lawn plastered with clay. A pipe drain may then be laid in the bottom and overlaid with rubble, on top of which is placed a layer of soil. A drain of this kind will prevent the lawn from becoming water-logged.

It often happens that houses are built on the top or side of a hill which makes it necessary to level the site. In such cases both the lawns and the flower garden have to be made upon solid unweathered subsoil, which is usually hard and impervious to water. The top soil in these cases should always be preserved, but there is usually only sufficient to provide a very shallow rooting medium and the hard-pan beneath prevents proper drainage. If the subsoil is broken up to a depth of one foot, and cut grass, leaf-mould or other organic matter is incorporated, and drains laid where necessary, before the top soil is replaced, a much more satisfactory lawn will result.

Soils.

The most suitable soil for grasses is usually a medium loam, which will absorb and retain moisture, but not set hard in dry weather. It often happens that Malayan soils are too heavy and bake hard when dry, which results in cracking. Sandy soils on the other hand do not provide satisfactory anchorage for the grass roots and plant foods are easily washed out of reach. Lawns and greens should therefore have a surface of four to six inches of good loam. Where good loam is not available *in situ*, the surface soil should be made as suitable as possible by incorporating organic matter in the form of cattle manure and jungle mould. On heavy soils a coarse-grained sand worked into the surface will improve its texture. In addition, a dressing of rock phosphate, basic slag or bone meal at the rate of two ounces per square yard incorporated with the surface soil before planting will be found beneficial. Very stiff soils may be improved by a dressing of lime at the rate of about one ton per acre.

When a site is being levelled, all surface soil should be removed and replaced afterwards. If levelling involves deep cutting and filling, the area should be allowed to settle for a month or two before finally levelling and planting, otherwise hollows in the lawn may result through sinking of the soil.

Planting.

Under Malayan conditions it is not possible to make a good lawn by sowing seed, owing to the fact that suitable seeds are not available and, if they were sown, there would be loss through the depredations of ants and other insects. Furthermore, grass seeds require sowing more or less on the surface, and they are either dried up by the hot sun or washed away by heavy rain.

Turf is usually out of the question for making tennis courts of golf greens, since good turf is not easily procurable. It is of course the quickest method but is expensive. Where a pure strain of grass and an even surface are not so essential, as for covering banks or making an ordinary lawn, turf may be used.

Since the production of turf from seed is unsatisfactory and good turf is usually unprocurable in Malaya, the usual method adopted is to dibble in divisions or shoots of desirable grasses. These are planted at about six inches apart in triangular formation and set slightly at an angle instead of erect. When the shoots are established they will rapidly cover the surface and form a compact turf within a few months. This applies to golf greens and tennis courts. For planting an ordinary lawn or playing field, Carpet grass dibbled in at 9 inches to one foot apart will cover the surface, and in good soil will form a good turf in from four to six months. At these distances it requires 25 to 30 bags of Bermuda grass or Blue Couch and 12 to 15 bags of Carpet grass to plant an acre.

Maintenance.

Turf Nursery.—Where golf greens, tennis courts or playing fields have to be kept in perfect condition, it is advisable to cultivate a turf nursery where the same type of grass turf can be obtained for filling in bare patches. This nursery should be prepared and kept as scrupulously as the lawn itself, otherwise it will be useless, except for the purpose of providing shoots for dibbling in. When cutting turf for repairs it should be of even thickness and the patches for its reception should be well prepared. The soil should be taken out to a sufficient depth to allow the turves to fit nearly level with the surface. The interstices between the turves are then filled in with fine soil, and the whole beaten down with a wooden beater to the level of the surrounding turf, after which it should be thoroughly watered.

Cutting and Rolling.

The effect of cutting grass is to increase the number of tillers from the base of the plant. It is therefore desirable to mow before the grass has commenced to throw up shoots or has made long runners. A newly-planted lawn should not be mown too closely at first, and should preferably be mown with a sharp scythe or a mowing machine set high. After the first mowing it is advisable to top-dress with fine soil. A light rolling on occasions is beneficial, but this should not be done when the soil is soft and wet or hard and dry. If the lawn is obviously unlevel, it is better to take up the turf and level the surface beneath, rather than to use a heavy roller for the purpose and compact the surface so that it bakes hard.

Watering.

It is often necessary to water during dry weather but, if this operation is not done properly, it can do more harm than good. Watering should not be carried out when the sun is shining, and it is essential when watering, to see that the soil gets a thorough soaking. A light sprinkling is worse than no water because it encourages shallow rooting, which limits the range from which the grass roots can feed, and it is liable to cause the grass to suffer from sun scorch.

Renovating.

Grasses may become thin, or bare patches may occur owing to over-rolling in wet weather, to hard wear, or to poor soil. Compacting may cause bad aeration of the soil at the surface and consequently a poor growth of grass. This can be remedied by piercing the surface with a spiked roller or straight pronged fork. When a fork is used it should be pressed straight down to its full depth and drawn straight out again. This operation should be followed by a top-dressing of good soil mixed with a little fertilizer, which should be brushed or rubbed well into the perforation made by the fork, or spiked-roller. Top-dressing golf greens or lawns with pure sand is not advisable, unless the surface soil is very heavy, since it tends to produce sun scorch. Where grass is merely thin and the surface soil in good condition, a top-dressing with fine soil and fertilizer will restore vigour, but where bare patches occur, the lawn should be rested and raked well to break up the surface and provide loose soil, so that the grass runners can take root. Fine soil and fertilizer may be broadcast over the surface and well worked in by brushing. The grass should then be left to grow to a height of three inches before cutting, and this should be repeated until the turf is restored. Do not allow the grass to reach the flowering stage before cutting. Where large bare patches occur, the area should be dug over, manured, and then replanted with grass.

Fertilizer Treatment.

Where proper attention has been paid to construction and drainage, the most common cause of poor turf is failure to manure. It must be remembered that the constant cutting of grass and removal of cuttings, combined with the ill-effects of heavy rainfall, causes rapid depletion of the available plant nutrients of the soil. Grasses usually have a shallow root system and can exploit only the top few inches of soil, from which available nutrients are easily washed down out of reach. No hard and fast rule can be laid down as to the frequency of fertilizer applications, since much will depend upon the soil. The appearance of the grass will indicate whether manures are required. As a general rule, it is better to apply small quantities frequently, than large quantities at long intervals.

Fertilizers may be applied either by mixing with 10 to 20 times their bulk of good dry loam, or by mixing with water and applying in solution. It is unwise to apply unadulterated fertilizers direct to the grass as scorching usually takes place. By mixing fertilizers with soil or water the fertilizers are more evenly distributed and scorching of the grass is obviated. When applying fertilizers mixed with loam, it is advisable to divide the area into sections, and apply even doses of the mixture by throwing it into the air with an upward sweeping movement of the arm, so that it falls evenly over the surface.

Where fertilizers are found to be necessary, the application of a complete mixture at the rate of 4 to 5 cwts. per acre at intervals of a year or eighteen months, with intermediate applications of sulphate of ammonia or calcium cyanamide at the rate of 1 to 2 cwts. per acre, if found necessary, should maintain

turf in good condition. For fine grasses on golf greens and lawns, frequent treatment with a complete fertilizer is essential, and sulphate of ammonia should be restricted according to requirements as shown by the growth of the grass; if it is too rank this should be withheld, but if it is lacking in vigour and is of a light colour, an application will be beneficial.

There are suitable proprietary, complete fertilizers such as "Enpekay" upon the market, or the manures containing nitrogen, phosphate and potash may be bought separately and mixed immediately before using. Suitable mixtures are as follows:—

		parts by weight
(*a*)	Sulphate of ammonia	2
	Superphosphate	2
	Bonemeal	2
	Sulphate of potash	1
(*b*)	Calcium cyanamide	2
	Basic slag	4
	Sulphate of potash	1

These mixtures may be applied at the rate of 1 to 2 lbs. per 100 square yards. Mixture (*b*) is suitable for heavy acid soils, or may be used alternately with mixture (*a*).

Weeds.

Tennis courts and golf greens require constant attention in this country or they become over-run by weeds. Poor soil and bad drainage usually accelerate this condition, therefore proper attention to manuring and drainage will save considerable time in weeding, and a better turf will result. For lawns in temperate climates special manures are sold for the purpose of eliminating weeds, and consist mainly of sulphate of iron and sulphate of ammonia mixed with fine sand. Coarse grasses, which are the weeds frequently found in golf greens and tennis courts in this country, cannot be kept out by manuring. The only way to eradicate them is to weed them out by hand as soon as they appear. Large deep-rooted weeds may either be removed by hand or by piercing the centres with a pointed steel skewer dipped in sulphuric acid, or a solution of one part sodium chlorate to two parts water.

Worms in Lawns.

Worms do a certain amount of good by aerating the soil, but where they are plentiful they are objectionable although their presence usually indicates that the soil is good. Apart from the fact that worm-casts form seed-beds for weeds, they make the surface uneven and unless they are swept away before rolling, they are liable to be pressed hard into the soil, forming small patches where grass will not grow. Worms may be eradicated by watering the lawn with a solution of one ounce perchloride of mercury in thirty gallons of water, and applied to 300 square yards of lawn, after which fifty gallons of pure water should be applied. The worms will come to the surface and may be brushed off. One pound of

copper sulphate dissolved in fifty gallons of water in a wooden tub, applied to 100 square yards of lawn is recommended for the same purpose by the British Board of Green-keeping Research.

Insect Pests.

Lead arsenate mixed with water in the proportion of 1½ lbs. to 50 gallons of water, and applied with a watering can at the rate of one gallon of the solution to two square yards of turf, is said to control grubs attacking grass land. Perchloride of mercury might also be effective in the proportion of two ounces to 30 gallons of water applied three times in one week at the rate of 10 gallons to 100 square yards. Caterpillar pests which cause damage to golf greens have been controlled with lead arsenate at the strength of 1½ lbs. to 50 gallons of water. "White ants" or termites sometimes damage lawns or greens by eating the young shoots at the base, causing bare patches. A method of locating and destroying the nests has been described by McNaughton (1), and is said to have been used with success at the Singapore Golf Club. This method is a rather laborious one, and consists in making holes with a crowbar at 18 inches apart and two feet deep over affected greens. These holes are plugged with grass, and if the crowbar has penetrated a run or nest, the termites will soon commence to repair the damage, and thus show their presence when the holes are examined. If a run is discovered in this way a cigarette tin full of carbon bisulphide is poured into each infected hole and ignited, the explosion thus caused forcing the flames and fumes into the tunnels and nest. Care is necessary when dealing with this chemical as it is highly inflammable, and igniting should preferably be done with a lighted cloth on the end of a long stick.

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THE RAMBUTAN AND ITS PROPAGATION

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Introductory.

The rambutan (*Nephelium lappaceum,* L.) is one of the most popular fruits of the Malayan region. It is cultivated throughout the Archipelago and is indigenous to that region, though probably not to the Peninsula, for it has not been found wild except as an escape from cultivation.

The tree is of medium size, from 30 to 50 feet in height, and when grown from seed usually has a straight stem with a compact head of branches. The leaves are alternate, petiolate and abruptly pinnate, with two to four pairs of leaflets which are arranged alternately or nearly opposite on the rachis. The leaflets are short-stalked and vary considerably in shape from elliptic to obovate, the apex being obtuse or bluntly acuminate. In texture the leaf blades are thinly coriaceous, glabrous above and glaucous beneath. When young, the leaflets are soft, light-green, and pubescent along the veins. The inflorescences are axillary and terminal, erect, rusty pubescent, with many greenish white flowers. The flowers are borne in fascicles along the rusty pubescent branches of the panicles and are unisexual, flowers of both sexes being borne in the same inflorescence. This separation of the sexes is carried further in some trees, so that they bear only male flowers, and therefore never produce fruits.

The flowering period in Malaya varies with the seasons and districts in which the trees are grown, but it usually takes place in April/May and September/October.

The fruits usually ripen in July/August and December/January. This does not mean that two crops of fruit are obtained from a tree each year, although this occasionally happens and, if so, one crop is usually small.

There is considerable variation in the fruits produced by different trees as regards size, colour and quality. The fruits are usually oval or ellipsoid, about $1\frac{1}{4}$ to 2 inches long by 1 to $1\frac{1}{2}$ inches broad, and covered with soft spines as much as half an inch in length. In colour they are of various shades of red or yellow. The aril within the pericarp is white and encloses one seed or nut; it varies in flavour from very sweet to distinctly acid, and may be thick or thin, adhering to the seed-coat or parting from it easily. The most desirable fruits are those of good sub-acid flavour with small seed and thick aril which parts easily and cleanly from the seed-coat.

The variation among the fruits of rambutan trees leads to the subject of this article. It is well known that when most cultivated fruits are grown from seed there is no certainty that the offspring will produce fruits of as good quality as the parent. In fact, it is often found that they do not. Consequently, vegetative propagation is the usual means of increasing stocks of fruit trees with desirable

characters. There are several methods by which fruit trees may be propagated vegetatively, and at least four of these may be applied to the rambutan, *viz.* marcottage, the etiolation method, budding and grafting.

Marcottage.

Apart from propagation from seed, the most common method, and the one that has been used in Malaya for many years, is marcottage (*tut*). This method has been used mainly by Chinese fruit-growers, and a number of orchards of very good varieties of rambutans propagated in this way, exist. Marcottage or tut, known in India and Ceylon as "gootee layering", is performed by selecting a suitable branch and, at a point where the wood is about 1 to $1\frac{1}{2}$ years old, removing a ring of bark about $1\frac{1}{2}$ inches long. The exposed cambium is scraped or left uncovered for a day to dry, then it is covered by a suitable compost consisting of soil, leaf mould, sand and moist cattle droppings, made to such a consistency that it can be moulded into a large ball round the part where the ring of bark is removed. This ball is surrounded with coconut fibre and the whole bound tightly in place with some suitable tying material. The ball is kept moist and roots appear six weeks to three months later; the rooted branch is subsequently removed from the tree.

It has been found at the Central Experiment Station, Serdang, that marcots taken from the old branches often die after being taken from the tree, and that younger branches of the age quoted above are more easily rooted and established. When the marcots are severed from the tree they are placed in pots in a shaded and sheltered position. They should be well watered when potted, but until they are established it is necessary to water carefully. There is usually a heavy mortality among marcots after being severed from the parent tree, therefore it is not an entirely suitable method of propagation for raising large numbers of plants. Furthermore the fruiting tree is mutilated if marcots are constantly taken from it.

The Etiolation Method.

The etiolation method of propagation has been previously described (4, 5 and 6) and is a form of layering. For this method, it is first of all necessary to obtain plants propagated by marcottage from the tree it is desired to propagate. These plants are planted in rows at an angle of approximately 30 degrees from the horizontal and, when established, are pegged down in shallow trenches until shoots appear. These shoots are earthed up gradually until the stems are covered to a depth of 5 to 6 inches. In the case of the rambutan, when the shoots are about a foot high and have become slightly woody, the earth is removed and fine wire is twisted round the shoot just above the point where it emerges from the main branch. The removal of a ring of bark is sometimes more effective. The earth is then replaced and in two to four months roots will appear. When sufficiently well-rooted, the shoots are removed from the parent plant and placed in a pot or bed in the shade, to become properly established before planting in permanent

quarters. This method has been successfully applied at Serdang and at certain of the smaller Agricultural Stations in Malaya. Although a slow process, it is a more economical method of increasing stocks of plants than marcottage.

Budgrafting.

The most economical method of propagation as regards material is budding or budgrafting. Fruit trees propagated by this method are usually more fruitful and, provided care in the selection of budwood has been carried out, they can be relied upon to bear fruits with the same or very similar characteristics as those of the parent. They usually fruit earlier than seedlings; in Java, for instance, budded rambutans produce fruit in the third or fourth year (8).

A budgrafted plant is made up of two parts: (a) the "stock" which is raised from seed or by some vegetative method, and (b) the "scion" or bud, which is obtained from the tree or plant it is desired to increase.

It is essential that the stock and scion should be closely related botanically. Usually it is possible to inter-graft plants only within the same genus, but certain species of different genera of the same natural order may be grafted or budded with success. Rambutans are best budded upon stocks of the same species.

Stocks.

These may be raised from seed or by vegetative means such as the "etiolation" method. By whichever means they are raised, only those which are vigorous in growth should be selected.

Where the raising of budded plants on a large scale is practised, the usual method is to raise seedlings in seed beds, and when they are of suitable size, *i.e.* about 6 inches high, they are transplanted into stock beds at about 12 to 15 inches apart. In this climate it is necessary to shade the plants for a time until they are well established.

If stocks are being raised by the etiolation method, they should be planted out in stock beds when they are well rooted.

It is essential that the beds for raising stocks should be well cultivated and manured some time before the stocks are planted, and it will be found necessary to manure at intervals during the growing period, to keep the plants in vigorous growth. The beds should also be watered during dry weather. When the stems of the stocks are a half to three-quarters of an inch in diameter and the plants are producing a flush of new leaves, they are ready to bud.

Budwood.

The success of the budding operation depends largely upon the selection of suitable budwood. This should be a branch or shoot well furnished with dormant buds, and should be obtained from the tree at a time when there is a new flush of growth. At this time the bark will easily part from the wood. Buds from mature wood about one year old from which the leaves have fallen (non-petioled)

are desirable in the case of rambutan. This tree retains its leaves rather persistently, consequently only a small number of dormant non-petioled buds are available. To overcome this, and to provide the maximum number of buds, the blades of the leaflets are cut off from the selected branch some time before the buds are required. This causes the petioles to drop off, leaving suitable buds for propagation.

Budwood, after being cut, should have all leaves removed; it should be transferred immediately to a shaded position, and its lower ends placed in water. If budwood is to be transported for some distance, the cut ends should be dipped in melted wax and then be wrapped in moist material such as green banana leaves, moist sacking, or water-proof paper, to prevent evaporation of moisture.

Method of Budgrafting.

There are various methods by which the rambutan may be budded, but the one adopted at the Central Experiment Station, Serdang, and also in Java, is known as the "Modified Forkert Method". This method is performed by making a transverse incision in the bark of the stock. The bark is carefully lifted and torn downwards or upwards in one or more strips by gripping it between the blade of the knife and the thumb. About two-thirds of this strip of bark is cut off, and the end of the bud-patch is inserted beneath the remains of the flap. When tied, this piece of bark helps to keep the bud-patch in place without pressing upon the bud.

The Budding Operation.

Budgrafting is best performed in dull cloudy weather, but provided the budwood is kept well shaded and the operation is done quickly, it can be carried out at any time except when it is raining or the plants are very wet.

The operation of budding is performed as follows. A bud is cut from the budwood by inserting the knife about one inch below the bud and drawing it inwards and upwards bringing it out at about one inch above the bud. A bud-patch with a thin piece of wood attached is obtained. This should be cut to the size and shape of the incision in the bark of the stock and the wood carefully removed. This process requires a little practice, for if the wood brings away with it the nodule of soft tissue behind the bud, leaving a small cavity, the work is often nullified. The bud-patch is then fitted to the incision in the stock, (care being taken that the cambiums of bud-patch and stock are in close contact), then tied firmly in place with raffia or other tying material. The buds are then shaded by tying over them a few leaves taken from the stock. Budding should be performed as rapidly as possible to avoid the drying of exposed tissue.

Seventeen to nineteen days after budding, the tying material is removed and the bud examined. If the bud-patch is alive it should be re-shaded and in a week or ten days' time examined again, when, if it is still green, the stock may be cut back to within six inches of the bud to encourage it to sprout. No other shoots should be allowed to grow upon the stock or the sprouting of the bud may be

FIG. 1. BUDWOOD SHOWING BUD-PATCH BEING REMOVED.

FIG. 2. STRIPPING DOWN BARK ON STOCK.

FIG. 3. BUD IN PLACE ON STOCK.

FIG. 4. BUD SHADED WITH LEAVES.

retarded. As the sprout from the bud develops, it should be supported by tying it to the stock and later to a stake. When the bud has grown to be a sturdy woody shoot, the remainder of the stock should be cut back neatly just above the union, and the cut surface covered with white paint. It has been found at the Central Experiment Station, Serdang, that an experienced budder will obtain 70 to 90 per cent. " takes".

After the stock has been cut back, some of the buds sprout in a few days, while others take a much longer time to burst into growth. This is probably due to lack of vigour in the stock, or to differences in development and vigour of the buds when taken from the budwood; therefore it is necessary to be careful in their selection.

The time taken, from the sprouting of the bud until it is ready for transplanting, also varies with the vigour of the shoot. There is much variation in this respect, but two to three months is the average time necessary for the more vigorous to be ready for transplanting to a permanent situation. A number of the more backward shoots eventually become strong plants, but it often happens that they remain weak; these should be discarded. The total time taken between the budding of the stock and the production of a plant large enough to be planted out is from 4 to 5 months.

Transplanting.

The rambutan, like a number of other tropical fruit trees, is intolerant of root disturbance, consequently the greatest care is required when transplanting budded plants from the nursery beds to their permanent quarters. It is advisable to sever the tap-root when the seedling stocks are about 6 months old by inserting, during wet weather, a long knife beneath the plant. When preparing the budded plant for the shock of removal from the beds, a certain number of the roots are severed about a month beforehand. This is best done by removing the soil at about 4 to 5 inches radius from the stem, and three quarters of the way round, leaving a ball of earth undisturbed; all roots which reach outside this area, and any secondary tap roots are cut and the soil replaced. If this is done during showery weather or if the plants are watered after the operation, the effect on the plant is negligible except that growth is retarded for a time; the growth of fibrous roots near the stem, however, is encouraged. If the plants are to be planted within a short distance of the nursery beds, they may be lifted with the ball of earth attached, wrapped in sacking and carefully transported to the place where they are to be planted. Great care is necessary or the ball of earth may be broken, and if this happens the plant may die. It is necessary to water liberally after planting and to provide heavy shade until the plant is established in its new position. The best time to lift the plants is between the flushes of new growth, *i.e.* when the terminal bud is comparatively dormant. Plants with a flush of young terminal growth at the time of removal from the nursery, often wither at the apex and die back to firm woody tissue.

The greatest difficulty so far encountered is the transport of plants for long distances. At first, plants were lifted from the nursery beds after preparation as described above. The ball of earth was wrapped firmly in sacking, the plants were packed in boxes and despatched to their destination either by lorry or the railway. Complaints were made that a number of these plants died after planting out. It was thought that this was due to the soil being loosened by vibration on the journey and when unpacked it fell away from the roots. To overcome this difficulty, the plants are now lifted from the beds and planted in earthenware pots 10 inches in diameter and 11 inches deep. The plants are established in these pots in dense shade at first, but later they are given more light until they will eventually withstand the full sun. So far, this method, although rather expensive, has been successful.

Another method is being tried at present, but it is too early to say what the result will be. This consists in sinking drain pipes vertically into nursery beds and growing the seedling stocks in them. With heavy manuring, after the plants are established, it is possible to obtain stocks vigorous enough for budding, but there is the possibility that the roots restricted in this way will become matted together close around the inside of the pipe, and this is not altogether desirable. The same objection applies to growing stocks in earthenware pots.

Owing to the rapid growth which takes place in the tropics and to the fact that the trees are evergreen, the methods practised in temperate climates with deciduous fruit trees are not applicable to the rambutan.

When the new orchard is being planted, or vacancies in an old orchard are to be filled, it would save time and the difficulty of transplanting, if 3 or 4 seedlings were planted in each hole at about one foot apart. When large enough they could be budded with the variety required, and the plant with the strongest shoot retained while the others are discarded. If this method were adopted, the plant would grow without check, and the expense of filling vacancies which occur through deaths after transplanting would be avoided.

Acknowledgments.

Thanks are due to Mr. J. L. Greig, Assistant Agriculturist, for taking the photographs accompanying this article.

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SAPUCAIA NUT, *LECYTHIS* SP.

BY

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The Sapucaia nut is the product of many species of giant forest trees of the order Lecythidaceae (united to Myrtaceae by some authorities) indigenous to the tropical zone of South America. The genus *Lecythis* flourishes in Colombia, Venezuela, Equador, Guiana, and Brazil.

The nut has been exploited to a limited extent as a jungle product and has been marketed principally in the countries to which it is indigenous, but a portion of the crop is exported to the United States, and occasional consignments reach the markets of Europe.

The Sapucaia or Sapucaya belongs to the same Natural Order as the Brazil nut, *Bertholletia excelsa*. The nut is reported to be far superior in flavour to the Brazil nut and it is considered by some authorities to be the finest nut in commerce. It commands a higher price than that of the Brazil nut, partly owing to its excellent qualities, but also to the limited supplies on the market. The nut of commerce is said to be derived principally from the species *Lecythis usitata* Miers., but the following species also produce edible nuts: *Lecythis ollaria, L. Pisonis* Camb., *L. Zabucayo* Aubl., and *L. lanceolata* Poir.

In general, many species of trees indigenous to the tropical belt of South America are suited to the climatic conditions prevailing in Malaya and examples that may be cited are *Hevea Braziliensis*, the plantation rubber tree, and *Bertholletia excelsa* (Brazil nut).

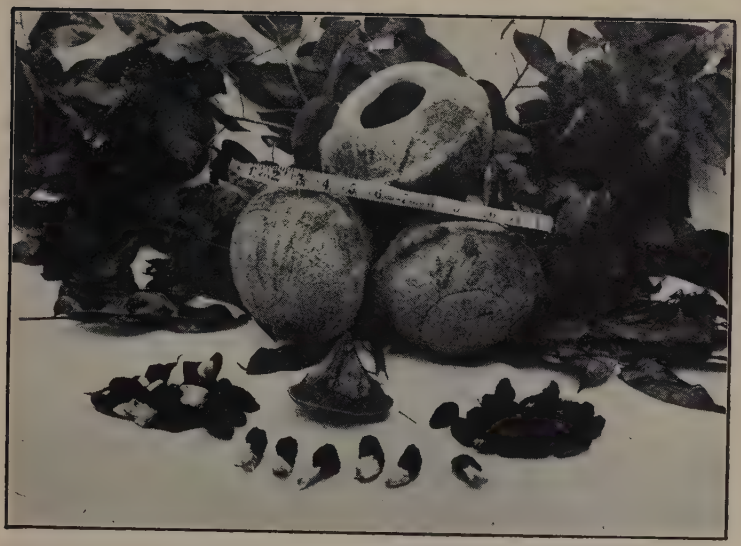
Introduction to Malaya.

Since the Sapucaia is not altogether suited to exploitation as a forest product as will be explained later, the possibilities of growing it under plantation conditions have been investigated at the Central Experiment Station, Serdang, since 1926. The Secretary for Agriculture, Mr. A. S. Haynes, in 1923 requested the Director of the Royal Botanic Gardens, Kew, London, to obtain from British Guiana seeds or plants of several species of Lecythis, and the writer brought out to Malaya from Kew during 1926 two plants each of the three species namely, *L. ollaria, L. Zabucayo* Aubl., and *L. Pisonis* Camb.

The six plants were established in the nursery at Serdang in July, 1926, and in November the same year they were transferred to a well-drained site in the arboretum on the Raub series of red laterite soil.

During the ten years the three introduced species have been under trial, *L. ollaria* has proved to be the most suited to conditions at Serdang.

Lecythis Zabucayo.—The two plants had made little initial growth at Kew and when they were taken out of the Serdang nursery before being planted out in November, 1926, they were 6 and 9 inches high respectively. They had attained a height of only 2 feet and were in a moribund condition in 1932 when they were uprooted.



Sapucaia, *Lecythis ollaria*.
Fruits and Nuts with Adhering Funicle.

Sapucaia, *Lecythis ollaria*.
Bunch of Unripe Fruits on the Tree.

Sapucaia, *Lecythis ollaria,* 10 years old.

Lecythis Pisonis was more vigorous than the species previously mentioned, and the plants were 1 ft. 9 ins. high when planted in the nursery. These two trees, although they had attained a height of 20 ft. at the end of 1936, had a bushy growth with no leading branch. The ends of the branches die back continually and, in general, the trees can be described as struggling to thrive under conditions not altogether suited to them; up to the present they have not flowered.

Lecythis ollaria has proved to be quite suited to Malayan conditions. The two plants introduced had made the greatest initial growth at Kew and in the Serdang nursery; they were 2 ft. 4 ins. high before being planted in the field.

In June, 1932, they were 18 ft. high, and in October, 1936, they had grown to a height of 36 feet with a spread from the trunk of 15 feet.

The trees have no pronounced main central leader, branching commencing about three feet from the ground. This form of growth may not be natural, but the result of growing the seedlings under artificial tropical conditions at Kew.

The girth measurement in October, 1936 at 2 feet from the ground was 5 feet.

Some Botanical Features of *L. ollaria*.

The branches grow from the main trunk at an angle of about 60 degrees, the secondary and tertiary branches have a similar habit, but grow in a horizontal direction; the wood is very flexible and the lower branches droop so that they almost reach the ground; the bark is very fibrous and tough.

The leaves are alternate, shortly petiolate 2½ to 6 inches long and 1½ to 2 inches broad; the leaf blades are narrowly ovate approaching a lanceolate form, entire, rounded at the base with an acuminate apex; the upper surface of the leaf is dark green, glabrous and glossy and the lower surface is duller, dark green and glabrous.

The flowers of *L. ollaria* are a delicate mauve, bleaching to white with age, having a fasciated and capped-over androphore with many hairs on the underside, which is typical of flowers of the order Lecythidaceae.

One tree flowered in March and early June, 1934, and ripened twelve fruits in January/February, 1935. These fruits were small, weighed up to 2 lbs. each and contained 25 to 30 nuts. The same tree flowered profusely during March/June, 1935, but only one large fruit ripened.

In 1936, both trees of this species flowered freely and the above mentioned one ripened about 81 fruits of varying sizes during the latter part of the year. The second tree produced 24 large-sized fruits; each weighed about 5 lbs. and contained 41 to 49 nuts.

These trees have a short wintering period similar to that of *Hevea Braziliensis*, and during 1936 this occurred in February/March. The flowers are normally produced at the same time as the new flush of leaves and some flowers appear on bare branches before the new leaves are developed.

The Sapucaia fruit is a large squat, conical, symmetrically shaped receptacle. The fruits grown at Serdang have varied in size to a maximum of about 8 inches in diameter and 6 inches deep; individual fruits weigh up to 5 lbs., the walls being

a light cinnamon colour, and composed of a hard close-grained wood one half to three-quarters of an inch thick. Serdang fruits have contained from 25 to 49 nuts which have a dark brown and very pronounced wrinkled coat about 1/16 of an inch thick, which fades to a cinnamon brown on exposure to the air. The shell is not so hard as that of the Brazil nut and the nuts are, in general, narrowly oval in shape with bluntly pointed ends, about two inches long and one inch thick at the centre. About 75 to 90 nuts weigh a pound, but this number will probably fall as the trees become more mature.

The fruit has the same general botanical features as those of the Brazil nut, the receptacle of which, however, has a small opercular opening through which the mature nuts cannot pass. To release the nuts, therefore, it is necessary to cut through the outer shell. The operculum in the Sapucaia nut is conical and 3 to 4 inches in diameter. When the fruit ripens, the cap or operculum loses moisture, and in consequence shrinks and distorts, dehisces and so permits the nuts to fall out. Although the weight of the fruit makes it hang upside down, or partly so, on the branch, the nuts do not fall out immediately, since they are attached to the base of the fruit by a large white fleshy funicle, which shrivels on drying and liberates them.

The kernel is white and rather oily and in taste and appearance resembles the Brazil nut to some extent.

The empty receptacle is known in South America as a "Monkey pot" and is reputed to be used as a trap to catch these animals by baiting it with nuts, molasses or sugar. The monkey inserts its hand into an anchored pot and closes it on the bait and rather than release the bait to withdraw the hand it permits itself to be caught.

The shell of the Sapucaya nuts being much softer than that of the Brazil nut does not preserve them from decay or germination on the moist jungle floor, or to the same extent, protect them from monkeys, rodents and peccaries. This characteristic has, unfortunately, an adverse influence on the keeping qualities of the nuts during transport and storage in bulk.

The natural scattering in the jungle of the comparatively soft-shelled nut on becoming ripe will explain why the Sapucaia is not very suitable for exploitation as a jungle product.

The whole question of its suitability to plantation conditions depends on the yielding capabilities of the trees which appear promising on the cropping results of the harvest of the two trees of *Lecythis ollaria*.

The actual yield of cleaned nuts from the two fruiting trees during 1936 was 23½ lbs. and allowing for a stand of 55 trees per acre this equals 646 lbs. cleaned nuts per acre. It is anticipated that these yields will be higher as the trees become more mature and it is probable that better pollination of flowers would take place in a larger stand of trees.

It would appear that an area of 5 to 10 acres of seedlings should be planted and individual yields of trees recorded for the selection of high-yielding clones from which budding material should be taken to use on to ordinary seedlings, so that earlier maturity might be induced and yields increased.

Whether the Sapucaia eventually proves to be suitable for large scale planting or not, it is very desirable that it be planted in kampongs and adjacent to private dwellings for the production of nuts for home consumption; a market will naturally develop for surplus production. Furthermore, the attractive foliage of *L. ollaria,* with its interesting fruits and the lengthy period the tree flowers, make it a useful addition in Malaya to the many species of ornamental trees for planting in parks and gardens.

Propagation from seeds has proved to be a successful method. When attempts were made to propagate the trees by marcottage it was found that although the usual callus was formed after ring-barking, roots were not produced. Propagation by the etiolation method is under trial, but insufficient time has elapsed to obtain results.

It would appear that cuttings would root successfully if placed in special propagators, since a small percentage of successes has been obtained in ordinary shaded beds.

The seed germinates in about two months after being sown and maintained in moist river sand in the open sun. The seedlings may then be transferred to bamboo joints or planting baskets. After approximately three months they attain a height of about 1 foot and may then be planted out in the field, provided the weather is suitable. The seedlings require shading until they are well established and have become sufficiently hardened to withstand the full sun. A spacing of 30 ft. x 30 ft. triangular would appear to be the minimum to be given, since the species *L. ollaria,* unlike the Brazil nut which fruits only near the apex of the tree, bears fruit down to a few feet from the ground level and for this reason adequate spacing is required.

Well-drained soils are essential for its development and it is recommended that large-sized planting holes, up to one cubic yard in capacity, be dug and filled with decaying vegetable matter and top soil, then mounded to a height of 6 to 9 inches above the surrounding ground level to allow for settling and shrinkage. The addition of about 1 lb. rock phosphate, ½ lb. calcium cyanamide, and ½ lb. sulphate of potash distributed in the planting hole as the filling proceeds would aid the growth considerably.

An attempt to introduce the Sapucaia to Malaya was made by the Manager, Devon Estates, Malacca, about 1925, who imported a barrel of nuts from which about half a dozen plants were raised, of which only one survives to-day in a garden in Penang. The tree is reported to be in a moribund condition. It is possible that the introduced species was not altogether suited to Malaya, moreover, weak plants may have been raised owing to the storage of the nuts for too long a period.

Summary.

A record of the introduction and trial of the tropical South America giant forest tree of three species of Lecythis (Sapucaia) is given with results to date.

The species *L. ollaria* appears quite suited to the climate of Malaya and is now well established at the Central Experiment Station, Serdang. *L. Zabucayo* has completely failed and *L. Pisonis* is only partially successful.

L. ollaria has taken 8¼ years from planting to the ripening of fruits.

Investigations into the economic possibilities of this crop are being continued. Meanwhile, the symmetrical growth of the tree, its handsome foliage with its ornamental flowers and fruits, suggest that it would be a useful addition to parks and gardens.

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Miscellaneous.

NOTE ON THE ESTIMATION OF ROTENONE IN DERRIS ROOT.

With reference to the article dealing with the evaluation of Derris root appearing in this Journal for October 1936 the authors wish to draw attention to certain experiments carried out recently by Dr. T. A. Buckley, Assistant Chemist, with *D. elliptica* (Singapore type) root regarding the extent to which rotenone is lost during the assay of the material. This type of root was selected on account of its comparatively high rotenone content.

As pointed out in the article mentioned above, rotenone may be lost at one or two stages of the process, thus some may not crystallize out from the carbon tetrachloride but may remain associated with resinous bodies in the mother liquor, while some may pass into solution when the complex is triturated with alcohol.

While it has not yet been found possible to devise a method for estimating the amount in the carbon tetrachloride mother liquor, determinations of the optical rotations of alcoholic filtrates after recovery of rotenone indicate that the loss in triturating the complex with alcohol amounts to approximately 6 per cent., calculated on the weight of rotenone recovered. Allowance was made in all cases for the rotenone introduced in the rotenone saturated alcohol. Thus, in the case of a sample of root of *D. elliptica* (Singapore type) in which 8 per cent. of rotenone is recovered, a more accurate indication of the rotenone content would be 8.48 per cent.

The total loss in the assay must be still greater owing to the retention of some rotenone in the carbon tetrachloride, but the low optical rotation of the residual bodies in this liquor points to a smaller degree of retention than with the alcohol liquor. The total loss may amount to possibly 10 per cent.

Further work is in progress to improve the accuracy of the assay method and to reduce if possible the loss of rotenone on purifying the complex.

C. D. V. G. and G. L. T.

Departmental.

FROM THE DISTRICTS.

Compiled for the Chief Field Officer from Monthly Reports from Agricultural Officers.

December, 1936.

The Weather.

During December, weather was normal for the time of year, being generally cool and wet.

In Kedah, however, rainfall was below average though it was well distributed. A steady north-east breeze, usually experienced during December, prevailed.

In Penang and the inland districts of Perak, heavy rain fell during the first three weeks of the month followed by dryer conditions during the last week. Some damage was done to the earlier plantings of padi in the north of Province Wellesley by heavy storms.

In the coastal districts of Perak and southwards to Singapore heavy rainfall, in many cases above average for the month, was general. In a few areas,—Kuala Pilah, Kota Tinggi and Kukup—rainfall was below average, and a particularly dry month was experienced in the inland area of north Selangor.

On the east coast in Pahang and Kelantan normal monsoon conditions prevailed with high precipitation, especially during the earlier part of the month.

Remarks on Crops.

Padi.—In the Kota Star North District of Kedah, the fungi noted on padi during November were identified as *Rhizoctonia solani* and *Sclerotium oryzae*. Harvesting has now commenced in this District and yields are below average. Elsewhere in Kedah the crop was commencing to ripen and prospects are good. It is anticipated that yields throughout the State will be about the same as they were last season.

Harvesting was commenced in the northern areas of Province Wellesley where lodging was rather extensive, and where the later plantings have suffered somewhat from stem-borers. Yields, however, are fairly good.

Flowering commenced in Krian, Perak North and Perak Central where there are good prospects of satisfactory crops. In Selangor (except the Kuala Selangor District) and Negri Sembilan harvesting was well advanced and yields were reported to be satisfactory. In the Panchang Bedena area irregular transplanting continues.

In Malacca and Central Johore harvesting commenced with good prospects and in the Segamat District of Johore where harvesting was completed, fairly satisfactory yields were obtained. In Pahang good crops were harvested during the month.

In Kelantan, flowering of dry padi commenced but prospects are indifferent owing to late planting in dirty seed-beds with consequent poor growth and excessive weeds. Flooding has caused damage to some of the wet padi which is nearing the harvesting stage.

Rubber.—Prices for rubber increased in all centres, increases ranging up to a maximum of $10 per picul in Perak North. In many instances reports are received of increased interest in the condition of holdings, and with the marked increase in returns, much clearing has been done. Wet weather interfered somewhat with tapping, which nevertheless was heavy in most districts. This may have been partly due to the need for ready cash for Hari Raya celebrations, partly to the anticipation of a new issue of coupons in the new quarter, and in some instances, as in Malacca, to the favourable price at which coupons could be bought.

Reports on smoke cabinets continue to indicate results varying from district to district. In some cases no interest is shown, while in others, the cabinets appear to be of value in giving a small extra profit. The first cabinet erected in Krian has now completed one year of service. It is in good condition although the sacking will shortly need replacement.

Coconuts.—The strong upward movement in prices was maintained, prices in some cases exceeding $9 per picul. A small drop in prices occurred towards the end of the month.

In all centres except Kelantan, where very wet weather prevailed, activity in the manufacture of copra is reported. In Johore, short supplies of nuts resulted in keen competition between Malays and Chinese to purchase available nuts. The better prices for copra together with increased demand during the fasting month caused high prices to rule for fresh nuts. In several instances prices as high as $70 per 1000 were recorded in inland districts.

Five new kilns were erected in Pahang. The new "Type 15" kiln was completed at Kampong Telok on the Bernam River, and the kiln at Parit Sungei Dulang was nearing completion.

Agricultural Stations and Test Plots.

At most of the Padi Stations and Test Plots flowering occurred or harvesting commenced. In the great majority of cases yields promise to be good, though rat damage is reported to have been serious in several instances. At Sungei Manik it was noted that rats showed a marked preference for Siam 29 and Mayang Ebus, blocks of these varieties having been singled out for severe attack. Kendong Plot shows a great improvement on previous seasons probably owing to the disappearance of the effects of levelling and re-designing.

DEPARTMENTAL NOTES.

Tours of the Adviser on Agriculture.

The Adviser on Agriculture made a tour of inspection from the 14th to 19th December, visiting Negri Sembilan, Malacca and Singapore. In Negri Sembilan he visited the Rembau Agricultural Station and the Kendong Padi Test Plot, and in Malacca the Sungei Udang Agricultural Station and Farm School, and the Pulau Gadong Padi Station were inspected.

In Singapore the Adviser visited the Pineapple Experiment Station, and presided at a meeting of pineapple packers and exporters.

The Adviser also visited Johore Bharu and interviewed the General Adviser, Johore, and the Financial Commissioner.

Leave.

Dr. T. A. Buckley, Assistant Chemist, has been granted 8 months and 5 days leave on full pay with effect from the 3rd December, 1936.

Mr. F. W. South, Chief Field Officer, has been granted 8 months leave on full pay prior to retirement with effect from the 5th December, 1936.

Statistical.

MARKET PRICES.

December, 1936.

Major Crops.

Rubber.—There was a spectacular rise in the rubber market after the Christmas holidays, the commodity improving by over 4 cents, but the price fell back sharply at the close of the month. Spot loose opened in Singapore at $31\frac{1}{4}$ cents per lb., and rose steadily to $35\frac{1}{2}$ cents on the 24th December; after the holidays it rose on the 29th to $39\frac{5}{8}$, falling to $39\frac{1}{8}$ on the 30th and closing at $37\frac{1}{8}$ cents.

The average price for the month of No. 1. X Rubber Smoked Sheet was 33.65 cents per lb. as compared with 30.37 cents in November. The London average price was 9.53 pence per lb., and the New York price 19.77 cents gold as compared with 8.56 pence and 17.84 cents gold in November.

Prices paid for small-holders' rubber at three centres during the month are shewn in the following table.

Table I.

Weekly Prices Paid By Local Dealers for Small-Holders' Rubber, December, 1936.

(Dollars per Picul.)

Grades.	Kuala Pilah, Negri Sembilan.			Kuala Kangsar, Perak.		Batu Pahat, Johore.				
	3	10	24	2	30	2	9	16	23	30
Smoked sheet	39.60	41.31		39.50						
Unsmoked sheet			42.50		45.00	37.50	39.16	39.70	41.77	47.50
Scrap										

Transport by F.M.S.R. lorry service Kuala Pilah to Seremban 12 cents per picul, to Malacca excluding duty, 25 cents per picul, by rail Seremban to Penang $1.24 per picul, Seremban to Singapore $8.00 per ton.

Transport from Batu Pahat to Singapore by lorry excluding duty, 90 cents per picul.

Transport from Kuala Kangsar to Prai by railway $6.20 per ton.

Transport from Kuala Kangsar to Singapore by railway $10.00 per ton (minimum consignment 5 tons).

At Kuala Pilah the standard deduction for moisture in unsmoked sheet is 5 per cent.

At Kuala Kangsar the standard deduction for moisture in unsmoked sheet is 10 per cent.

No purchases at Kuala Kangsar on the 9th, 16th and 23rd December, and at Kuala Pilah on the 17th and 31st December.

Palm Oil.—Prices for the Malayan commodity rose steeply during the month, and are shewn in Table II.

Table II.
Prices of Palm Oil and Palm Kernels.

Date 1936.	Palm Oil in Bulk, c i.f landed weight Liverpool/ Halifax.	Palm Kernels, c.i.f. landed weight London/ Continent
	per ton	per ton
December 4	£ 24. 10 0	£ 14. 0. 0
„ 11	25. 0. 0	15. 5. 0
„ 18	28. 0. 0	16. 10. 0
„ 24	28. 0. 0	16. 10. 0

Copra.—There was a further considerable advance in the market during December. The sun-dried grade opened in Singapore at $8.05 per picul, rising to $9.25 on the 17th December; it weakened to $8.75 on the 23rd, but improved again to close at $9.50, with an average price for the month of $8.86 per picul as compared with $7.13 in November. The mixed grade averaged $8.57 per picul as compared with $6.79 in the previous month.

Copra cake remained unchanged at $2 per picul.

Rice.—The average wholesale prices of rice per picul in Singapore in November were as follows.—Siam No. 2 (ordinary) $4.06, Rangoon No. 1 $3.47, Saigon No. 1 $3.72, as compared with $3.71, $3.30 and $3.40 respectively in October. The corresponding prices in November 1935 were $3.89, $3.72 and $3.55.

The average retail market prices in cents per gantang of No. 2 Siam rice in November were: Singapore 26, Penang 30, Malacca 26, as compared with 24, 29 and 26 respectively in October.

The average declared trade value of imports of rice in November was $3.47 per picul, as compared with $3.55 in October and $3.60 in September.

Padi.—The Government Rice Mill, Krian, maintained its price unchanged at $1.90 per picul during November. Retail prices of padi ranged from 6 to 12½ cents per gantang.

Pineapples.—Prices per case of canned pineapples remained unchanged at the October closing levels, and were: Cubes $3.05, Sliced Flat $2.85, Sliced Tall $3.15.

Prices of fresh fruit per 100 were as follows:—Singapore $2 to $2.30; Johore, 1st quality $1.60 to $4, 2nd quality $1.10 to $3, 3rd quality 60 cents to $2; Selangor $1.20 to $1.55.

Beverages.

Tea.—Five consignments of Malayan tea were sold on the London market during December. Two consignments were of lowland tea and sold for 11½d. and 11¾d. per lb.; the upland tea averaged 1s. 0½d. and 1s. 0¾d. per lb.

Average London prices per lb. during December for consignments of tea from other countries were as follows:—Ceylon 1s. 2.56d., Java 11.43d., Indian Northern 1s. 0.59d., Indian Southern 1s. 0.48d., Sumatra 10.30d.

The latest Colombo average prices available, quoted from the Weekly Tea Market Report, 15th December 1936, of the Colombo Brokers' Association are as follows, in rupee cents per lb:—High Grown Teas 76 cents, Medium Grown Teas 70 cents, Low Grown Teas 67 cents.

Coffee.—There was a further improvement in coffee prices during December. Sourabaya coffee averaged from $15.16 to $16.31 per picul, and Palembang averaged $12.38 to $13.88 per picul, as compared with the November respective averages of $13.56 to $14.81 and $10.12 to $12.19.

Spices.

Arecanuts.—The following are the averages of the ranges of Singapore prices per picul during December: Splits $4.81 to $7.19; Red Whole $5.12 to $5.88, Sliced $8.44 to $9.63.

The Singapore Chamber of Commerce quotations were: Best $7.75, Medium $7.25, Mixed $6.80 per picul.

Pepper.—Singapore prices improved during December but there was little demand. Average prices per picul were: Singapore Black $10, Singapore White $17.50, Muntok White $18.12, as compared with $8.44, $16.25 and $16.75 respectively in November.

Nutmegs.—Singapore prices remained steady throughout the month at $30 per picul for both 110's and 80's as compared with the November average of $29.50.

Mace.—Siouw improved to $105 per picul, at which price it remained unchanged throughout the month, and Amboina continued at $75 per picul. The November average prices were $100 and $73 per picul respectively.

Cloves.—Quotations are still nominal, but rose to $45 per picul for both Zanzibar and Amboina.

Cardamoms.—Green cardamoms were quoted during December in the Ceylon Chamber of Commerce reports at Rs. 2.00 to Rs. 2.23 per lb.

Miscellaneous.

Derris (Tuba Root).—The Singapore market during December was quiet and practically lifeless due to lack of enquiry. Prices remained unchanged; roots sold on a basis of rotenone content $46 per picul; on a basis of ether extract $28 per picul.

Gambier.—Block improved to $6 per picul as compared with $5.25 in November, and No. 1 Cube continued unchanged at $10.50 per picul.

Tapioca.—Prices in Singapore continued unchanged; Flake Fair $5.50, Seed Pearl $5.75, Medium Pearl $6.50.

Sago.—Pearl, Small Fair continued unchanged at the November level of $4.60 per picul. Flour, Sarawak Fair, weakened, averaging $3.06 per picul as compared with $3.19 in November.

Tobacco.—The general range of prices per picul was: 1st quality $18 to $33, 2nd quality $15 to $32, 3rd quality $10 to $17. In Kedah the range was $40 to $42; $30 to $32; $20 to $22; in Kelantan the range was $80; $65 and $50; in Johore prices ranged from $34 to $90.

Charcoal.—In the November issue of this Journal it was stated that "this commodity is again in demand at prices which leave a reasonable margin of profit". Recent information on this subject reveals that, in connexion with the industry in Ceylon, exports from that country have shewn a rapid increase, the peak month being in October last when 130,284 cwts. of coconut shell charcoal were exported to the United Kingdom. Compared with the exports in previous months this increase is phenomenal. This sudden increase in the demand for charcoal by the United Kingdom is said to be due to the decision to manufacture 45 million gas masks in which coconut shell charcoal is used.

The above prices are based on London and Singapore daily quotations for rubber; on the Singapore Chamber of Commerce Weekly Reports for the month and on other local sources of information. Palm oil reports are kindly supplied by Messrs. Guthrie & Co. Ltd., Kuala Lumpur; the Singapore prices for coffee and arecanuts by the Lianqui Trading Company of Singapore, and tuba prices by Messrs. Kohyei & Co., Singapore.

1 picul = 133⅓ lbs. The Dollar is fixed at two shillings and four pence.

Note.—The Department of Agriculture will be pleased to assist planters in finding a market for agricultural produce. Similar assistance is also offered by the Malayan Information Agency, 57 Trafalgar Square, London, W.C. 2.

GENERAL RICE SUMMARY.*

November, 1936.

Malaya.—Imports of foreign rice during November were 64,674† tons, and exports 16,487 tons, net imports being 48,187 tons. Net imports for the eleven months totalled 488,732 tons as compared with 445,747 tons in 1935¶.

Of the November imports 57 per cent. were consigned to Singapore, 10 per cent. to Penang, 9 per cent. to Malacca, 19 per cent to the Federated Malay States, and 5 per cent. to the Unfederated Malay States. The imports by countries of origin were as follows (in tons, percentages in brackets):—Siam 45,704 (70.7); Burma 14,649 (22.6); French Indo-China 3,701 (5.7); other countries 620 (1.0).

Of the November exports 68 per cent. were consigned to the Netherlands Indies, and 32 per cent. to other countries. The various kinds of rice exported were as follows (in tons, percentages in brackets):—Siam 14,266 (86.5); Burma 1,528 (9.3); French Indo-China 559 (3.4); parboiled 89 (0.5); local production 45 (0.3).

India and Burma.—Foreign exports for the period January to October 1936 totalled 1,163,000 tons, as compared with 1,519,000 tons in 1935, a decrease of 23.4 per cent. Of these exports 3.5 per cent. were to the United Kingdom, 16 per cent. to the Continent of Europe, 29.3 per cent. to Ceylon, 21.7 per cent. to the Straits Settlements and the Far East, and 29.5 per cent. to other countries. The corresponding 1935 percentages were 3.9, 9.9, 25.0, 31.9 and 29.3.

Siam.—Exports of rice and rice products from Bangkok during September were 153,183 tons; the total for the nine months was 1,232,034 tons as compared with 1,118,169 tons in 1935.

A telegraphic report on rice crop conditions from 60 various provinces of Siam for November, 1936, concludes as follows:—

Cultivated Area: The area planted at the end of November was approximately 7,219,006 acres, compared with 7,870,457 acres in the previous year, a decrease of 651,451 acres.

Damaged Area: Up to the time of this report, the damaged area is estimated to be 1,296,295 acres, against 815,440 acres of last year's crop at the same period.

Harvested Area: About 581,837 acres have been harvested up to the end of November, with approximate yields of 325,686 tons of padi. At the same time last year, 626,397 acres were harvested, yielding about 360,724 tons of padi.

Japan.—The demand and supply for the present rice year on the basis of the stocks on November 1 and the second rice crop forecast have been estimated as follows:—

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* Abridged from the Rice Summary for November 1936, compiled by the Department of Statistics, Straits Settlements and Federated Malay States.

† Tons = long tons (2,240 lbs.).

¶ It is to be understood throughout the summary that all comparisons and percentage increases or decreases are in relation to the corresponding period of 1935.

		Tons.	
Supply:			
November 1, 1936, rice stocks	...	1,123,000	
Second crop forecast	...	9,311,000	
Estimated imports from Korea	...	1,122,000	
Estimated imports from Formosa	...	701,000	12,257,000
Demand:			
Estimated consumption	...	10,379,000	
Estimated exports and to colonies	...	65,000	10,444,000
Estimated stocks on November 1, 1937	...		1,813,000

French Indo-China.—Entries of padi into Cholon during the period January to November 1936 inclusive totalled 1,436,909 tons, as compared with 1,533,208 tons in 1935, a decrease of 6.3 per cent. Exports of rice during the same period were 1,624,123 tons, as compared with 1,637,171 tons in 1935, a decrease of 0.8 per cent.

The Netherlands Indies.—According to *The Netherlands Indies Economic Bulletin*, Vol. IV, No. 18-19, dated 1st October, 1936, the area under padi harvested from 1st January to 31st July, 1936, amounted to 7,945,990 acres as compared with 7,797,790 acres for the corresponding period of 1935, an increase of 1.9 per cent.

Imports of rice into the Netherlands Indies from 1st January to 31st July, 1936, amounted to 138,797 tons as compared with 263,074 tons for the corresponding period of 1935, a decrease of 47.2 per cent.

Ceylon.—Imports during January to November 1936 totalled 479,151 tons as against 485,772 tons in 1935, a decrease of 1.4 per cent. Of the 1936 imports 13.6 per cent. were from British India, 62.5 per cent. from Burma, 0.4 per cent. from the Straits Settlements, and 23.5 per cent. from other countries. The corresponding 1935 percentages were 12.8, 67.2, 0.8 and 19.2.

Europe and America.—Shipments from the East to Europe during the period 1st January to 8th November totalled 1,152,379 tons, as compared with 639,597 tons in 1935, an increase of 80.2 per cent. Of the 1936 shipments 25.8 per cent. were from Burma, nil from Japan, 39.5 per cent. from Saigon, 9.3 per cent. from Siam, and 0.8 per cent. from Bengal. In 1935 the corresponding percentages were 50.3, 3.7, 39.5, 4.8 and 1.7.

Shipments for the Levant from the 1st January to 5th November 1936 were 13,106 tons, a decrease of 54 per cent. as compared with 28,488 tons in 1935. Shipments for Cuba, West Indies and America from 1st January to 7th November were 224,637 tons, as compared with 218,075 tons in 1935, an increase of 3 per cent.

MALAYAN AGRICULTURAL EXPORTS, NOVEMBER, 1936.

PRODUCT.	Net Exports in Tons				
	Year 1935	Jan.-Nov. 1935	Jan.-Nov. 1936	November 1935	November 1936
Arecanuts ...	21,885	19,637	24,946	935	1,165
Coconuts, fresh † ...	106,272†	97,620†	107,493†	6,997†	8,724†
Coconut oil ...	35,911	32,006	43,155	3,736	3,864
Copra ...	111,752	95,455	69,582	11,412	6,838
Gambier, all kinds ...	2,837	2,657	2,012	217	253
Oil cakes ...	11,361	9,855	14,083	953	948
Palm kernels ...	3,892	3,537	4,674	419	541
Palm oil ...	24,996	22,567	26,646	3,516	2,874
Pineapples canned ...	73,923	65,057	70,900	5,898	3,097
Rubber ¶ ...	378,381¶	353,175¶	332,061¶	26,444¶	30,103¶
Sago,—flour ...	10,920	8,490	6,586	545	347
,, —pearl ...	4,655	4,267	3,047	328	253
,, —raw ...	7,735*	6,915*	6,868*	826*	809*
Tapioca,—flake ...	1,953	1,800	1,416	175	113
,, —flour ...	755*	605*	1,956*	81*	353*
,, —pearl ...	17,169	15,690	16,032	648	1,330
Tuba root ...	567	519	566	50	50

† hundreds in number. * net imports. ¶ production.

MALAYAN PRODUCTION OF PALM OIL AND KERNELS (IN LONG TONS)

(As declared by Estates)

Month 1936	Palm Oil		Palm Kernels	
	F.M.S.	U.M.S.	F.M.S.	U.M.S
January ...	1,395.4	326.5	258.6	37.2
February ...	1,531.9	372.4	244.2	54.6
March ...	1,878.4	534.5	302.9	88.0
April ...	1,410.6	446.8	250.0	80.0
May ...	1,346.1	644.8	238.1	114.6
June ...	1,557.4	658.3	245.5	100.9
July ...	2,270.5	975.7	349.1	147.6
August ...	2,963.2	1,029.0	419.2	163.0
September ...	2,671.5	969.9	394.2	136.9
October ...	2,312.3	928.6	434.6	133.0
November ...	1,917.2	462.0*	314.5	82.0*
Total ...	21,254.5	7,348.5	3,450.9	1,137.8
Total January to November 1935	16,187.1	5,435.9	2,437.7	775.2
Total for year 1935 ...	17,338.7	5,764.6	2,711.1	818.4

* Johore and Kelantan Returns incomplete.

MALAYAN RUBBER STATISTICS

ACREAGES OF TAPPABLE RUBBER NOT TAPPED ON ESTATES OF 100 ACRES AND OVER, FOR THE MONTH ENDING 30TH NOVEMBER, 1936.

STATE OR TERRITORY	Acreage of Tappable Rubber end 1935	ESTATES WHICH HAVE ENTIRELY CEASED TAPPING		ESTATES WHICH HAVE PARTLY CEASED TAPPING (a)		AREA OF TAPPABLE RUBBER NEVER BEEN TAPPED		Total (5) + (7)	Percentage of (9) to (2)
		Acreage	Percentage of (3) to (2)	Acreage	Percentage of (5) to (2)	Acreage	Percentage of (7) to (2)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
STRAITS SETTLEMENTS :—									
Province Wellesley	44,526	400	0.9	15,963	35.8	422	0.9	16,363	36.7
Malacca	121,601	3,490	2.9	28,770	23.6	2,858	2.4	32,260	26.5
Penang Island	2,575	675	26.2	503	19.5	264	10.3	1,178	45.7
Singapore Island	34,525	5,526	16.0	8,844	25.6	334	1.0	14,370	41.6
Total S.S. ...	203,227	10,091	5.0	54,080	26.6	3,878	1.9	64,171	31.6
FEDERATED MALAY STATES :—									
Perak	294,988	9,962	3.4	67,083	22.7	13,763	4.7	77,045	26.1
Selangor	332,165	10,253	3.1	61,174	18.4	14,825	4.5	71,427	21.5
Negri Sembilan	258,304	11,081	4.3	52,121	20.2	15,976	6.2	63,202	24.5
Pahang	77,210	11,054	14.3	23,507	30.5	16,135	20.9	34,561	44.8
Total F.M.S. ...	962,667	42,350	4.4	203,885	21.2	60,699	6.3	246,235	25.6
UNFEDERATED MALAY STATES :—									
Johore	432,443	33,588	7.8	58,022	13.4	38,559	8.9	91,610	21.2
Kedah	199,607	14,699	7.3	25,321	12.7	15,329	7.7	40,020	20.0
Kelantan	30,474	403	1.3	9,058	29.7	3,885	12.7	9,461	31.0
Trengganu (b)	4,643	Nil	Nil	Nil	Nil	138	3.0	Nil	Nil
Perlis (c)	1,575	Nil	Nil	761	48.3	59	3.7	761	48.3
Brunei	6,010	Nil	Nil	1,562	26.0	963	16.0	1,562	26.0
Total U.M.S. ...	674,752	48,690	7.2	94,724	14.0	58,933	8.7	143,414	21.2
TOTAL MALAYA ...	1,840,646	101,131	5.5	352,689	19.2	123,510	6.7	453,820	24.7

Notes :—(*a*) Area out of tapping on Estates which have partly ceased tapping refers to areas definitely being rested and excludes areas on any tapping round.
(*b*) Registered Companies only.
(*c*) Rendered quarterly.

MALAYAN RUBBER STATISTICS

TABLE I

STOCKS, PRODUCTION, IMPORTS AND EXPORTS OF RUBBER, INCLUDING LATEX, CONCENTRATED LATEX AND REVERTEX, FOR THE MONTH OF NOVEMBER, 1936, IN DRY TONS.

State or Territory	Stocks at beginning of month 1			Production by Estates of 100 acres and over		Production by Estates of less than 100 acres estimated 2		Imports during the month		Imports January to Nov. 1936		Exports including re-exports during the month		Exports including re-exports January to Nov. 1936		Stocks at end of month			Consumption 3	
	Ports	Dealers	Estates of 100 acres and over	during the month	January to Nov. 1936	during the month	January to Nov. 1936	Foreign	From Malay States & Labuan	Foreign	From Malay States & Labuan	Foreign	Local	Foreign	Local	Ports	Dealers	Estates of 100 acres and over	during the month	January to Nov. 1936
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
MALAY STATES :—																				
Federated Malay States ...	...	7,511	11,501	10,541	112,426	4,603	58,678	Nil	Nil	Nil	Nil	13,872	2,927	129,193	42,981	...	5,379	11,968	10	107
Johore ...	...	2,726	4,143	4,319	45,301	3,177	35,375	Nil	22	Nil	791	2,103	5,485	25,081	55,441	...	2,558	4,241	...	...
Kedah ...	...	480	2,912	2,721	28,415	867	8,454	Nil	Nil	Nil	Nil	1,618	1,917	15,880	21,109	...	355	3,090	...	...
Perlis ...	...	24	17	12	124	17	215	Nil	Nil	Nil	Nil	Nil	38	Nil	331	...	18	14	...	...
Kelantan ...	...	305	282	230	3,143	562	6,397	Nil	Nil	Nil	Nil	121	580	1,615	7,798	...	417	261	...	...
Trengganu ...	...	55	50	190	2,444	95	1,222	Nil	Nil	Nil	Nil	Nil	285	Nil	3,666	...	55	50	...	...
Brunei ...	...	24	37	54	495	66	701	...	...	...	...	...	131	...	1,199	...	6	44	...	...
Total Malay States	...	11,125	18,942	18,067	192,348	9,387	111,042	Nil	22	Nil	791	17,714	11,363	171,769	132,525	...	8,788	19,668	10	107
S. SETTLEMENTS :—																				
Malacca ...	...	1,991	1,087	1,098	11,269	521	6,329	Nil		Nil		2,348		26,679			1,802	1,136	...	...
Province Wellesley ...	...	1,060	544	429	4,514	220	2,370	Nil		Nil		6,765		80,191		...	1,315	573	...	...
Penang ...	2,024	3,504	7	15	168	94	925	2,484	11,558	28,533	126,329		Nil		Nil	...	1,315	7	...	...
Singapore ...	4,814	14,251	171	127	1,532	129	1,388	14,359		128,790		20,515		202,789		1,071	4,250	166	29	290
Labuan ...	...	14	Nil	Nil	Nil	16	176	80		721		Nil		Nil		5,724	15,716	...	...	...
Total Straits Settlements ...	6,838	20,820	1,809	1,669	17,483	980	11,188	16,923	11,558	158,044	126,329	29,628	Nil	309,659	Nil	6,795	23,097	1,882	29	290
Total Malaya ...	6,838	31,945	20,751	19,736	209,831	10,367	122,230	16,923	11,580	158,044	127,120	47,342	11,363	481,248	132,525	6,795	31,885	21,550	39	397

TABLE II
DEALERS' STOCKS, IN DRY TONS 3

Class of Rubber	Federated Malay States	S'pore	Penang	Province We'sly D'dings M'cca.	Johore	Kedah
22	23	24	25	26	27	28
DRY RUBBER	4,292	15,402	4,114	2,866	2,051	216
WET RUBBER	1,087	314	136	271	507	139
TOTAL ...	5,379	15,716	4,250	3,137	2,558	355

TABLE III
FOREIGN EXPORTS

PORTS	For month	January to Nov. 1936
29	30	31
Singapore ...	31,068	305,118
Penang ...	10,986	117,706
Port Swettenham.	5,161	55,039
Malacca ...	127	3,565
MALAYA ...	47,342	481,428

TABLE IV
DOMESTIC EXPORTS 4

AREA	For month	January to Nov. 1936
32	33	34
Malay States ...	28,942	304,159
Straits Settlements	2,648	27,971
MALAYA ...	31,590	332,130

Notes :—

1. Stocks on estates of less than 100 acres and stocks in transit on rail, road or local steamer are not ascertained.
2. The production of estates of less than 100 acres is estimated from the formula : Production + Imports + Stocks at beginning of month = Exports + Stocks at end of month, + Consumption, *i.e.*, Column [7] = Columns [13] + [14] + [17] + [18] + [19] + [20] − [2] − [3] − [4] − [5] − [9] − [10]. For the Straits Settlements the production of estates of less than 100 acres is represented by sales or exports as shown by cess paid.
3. Dealers' stocks in the Federated Malay States are reduced to dry weights by the following fixed ratios: unsmoked sheet, 15% wet sheet, 25% scrap, lump, etc., 40%; stocks elsewhere are in dry weights as reported by the dealers themselves.
4. Column (33) and (34) represent exports of rubber subject to regulation which, for Singapore and Penang Islands are represented by sales or exports as shown by cess paid.
5. All statements are brought up to date monthly, and any inaccuracies that may be disclosed are corrected in the totals; the latest publication, therefore, is always the most reliable.
6. The above, with certain omissions, is the Report published by the Registrar-General of Statistics, S.S. and F.M.S., at Singapore on 24th December, 1936.

METEOROLOGICAL SUMMARY, MALAYA, NOVEMBER, 1936.

Locality.	Air Temperature in degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine.		
	Means of			Absolute Extremes						Total.		Most in a day.	Number of days.					Total.	Daily Mean.	Per cent.
	A. Max.	B. Min.	Mean of A and B.	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot	At 4 feet			Amt.	Precipitation .01 in or more	Precipitation, .04 in or more	Thunder-storm	Fog morning obs.	Gale force 8 or more			
	°F	°F	°F	°F	°F	°F	°F	°F	°F	in.	mm.	in.						Hrs.	Hrs.	
Railway Hill, Kuala Lumpur, Selangor ...	89.7	72.6	81.1	95	71	82	74	83.9	84.7	7.25	184.2	1.54	18	15	7	2		141.15	4.71	39
Bukit Jeram, Selangor ...	87.5	72.5	80.0	91	71	81	74	83.3	85.0	8.26	209.8	1.25	22	18	2			165.20	5.51	46
Sitiawan, Perak ...	87.8	73.0	80.4	91	70	79	75	83.7	84.5	8.58	217.9	1.32	20	15	1			175.35	5.85	49
Temerloh, Pahang ...	86.3	72.5	79.4	92	70	78	75	84.0	85.4	12.54	318.5	2.37	24	20	4	1		138.50	4.62	39
Kuala Lipis, Pahang ...	86.0	71.4	78.7	91	69	75	73	82.7	84.1	8.13	206.5	1.09	24	21		14		133.85	4.46	37
Kuala Pahang, Pahang ...	83.1	73.8	78.5	86	72	74	77	81.3	83.7	22.30	566.4	4.41	20	18			1	125.35	4.18	35
Kallang Aerodrome, S'pore ...	84.9	75.0	79.9	88	73	79	78	81.3	82.9	12.01	305.1	1.97	24	19	5			132.85	4.43	37
Butterworth, Province Wellesley ...	86.7	73.5	80.1	91	71	81	76	84.3	85.4	9.52	241.8	1.86	16	13	2			186.10	6.20	53
Bayan Lepas Aerodrome Penang ...	86.5	74.6	80.5	90	71	81	78	83.0	83.9	9.48	240.8	3.18	18	14	3			176.25	5.87	50
Bukit China, Malacca ...	85.0	73.5	79.3	88	71	79	75	82.5	83.6	9.77	248.2	1.68	22	18	3			163.90	5.46	45
Kluang, Johore ...	86.7	71.7	79.2	91	70	76	73	81.3	82.1	4.44	112.8	0.55	20	19	4	4	1	121.85	4.06	34
Bukit Lalang, Mersing, Johore	83.4	72.1	77.7	89	71	76	73	80.2	80.7	18.82	478.0	2.51	23	21	1		5	114.60	3.82	32
Alor Star, Kedah ...	86.3	72.5	79.4	91	71	77	76	82.8	84.2	7.22	183.4	2.01	15	13		1		172.55	5.75	48
Kota Bahru, Kelantan ...	84.2	73.3	78.7	89	71	79	76	82.3	84.0	24.02	610.1	5.91	24	21	1	1		135.10	4.50	38
Kuala Trengganu, Trengganu	83.8	73.0	78.4	87	71	77	76	80.9	81.7	34.34	872.3	7.39	23	22		1	2	144.50	4.82	41
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.	71.4	61.6	66.5	78	59	63	63	71.6	72.3	7.17	182.1	1.24	25	24		20		101.30	3.38	28
Cameron Highlands, Tanah Rata, Pahang 4750 ft. ...	71.3	58.1	64.7	76	53	66	62	70.4	70.4	11.70	297.2	2.67	26	21	1	1	2	113.95	3.80	32
Cameron Highlands, Rhododendron Hill, Pahang 5120 ft. ...	70.9	59.2	65.1	75	57	64	61			10.73	272.3	2.03	25	21			2	120.85	4.03	34

Compiled from Returns supplied by the Meteorological Branch, Malaya.